Revisiting "The Long-Run Evolution of Energy Prices"

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Overview

Robert Pindyck's seminal article (1999) in the Energy Journal on the long-run evolution of energy prices has been cited in numerous studies. His work spanned up to 127 years of prices of oil, coal, and natural gas. He raised questions on how to model the dynamics and long-run path of energy prices.

Our objective is to examine how well his models and projections captured the movements in prices for oil, coal, and natural gas since them. We begin by attempting to replicate his earlier study using the data from 1870-1996 and then update the data through 2012. This has been a period of structural changes with greater impact from natural gas price deregulation and production techniques, changes in global demand, geopolitical strife, and the role of commodities as an asset class in financial markets. Then we will use the updated models to make projections to 2025.

Energy price forecasting is a dangerous activity given the known unknowns and the unknown unknowns. Nevertheless producers and consumers need to have forecast for strategic planning purposes like investment decisions related to exploration, reserve development, production, fuel choices for power plants, petrochemical plants, and transportation, and environmental issues.

Methods

The first step in the project is to develop the database following Pindyck's documentation. We have checked this *separately* and conclude we have a consistent set of data. A major problem is that the government price series have undergone rebasing and definitional changes.

Second we examine the stationarity properties over the full sample and subsamples. This includes examining the data graphically, autocorrelation functions, and test for orders of integration.

Third, we build different univariate models of the price process using ARIMAX and structured time series or unobserved components models like the Kalman filter. These will compare how well Pindyck's original model continues to hold up – how stable and robust they are. The unobserved components are supposed to capture the level and trend dynamics due to extraction costs, resource base, and demand. EIA has annual data on drilling costs 1960- 2009 for crude and natural gas. We can use this data as a proxy for at least one of the factors in a KF model framework. We are still trying to find similar data for use in the modelling of coal prices.

Fourth, we will attempt to build multivariate type models of the three prices.

Fifth, we conduct within sample and out of sample forecasts to 2025 with the different models.

Results

We have completed the analysis of stationarity by examining the times series properties of the prices for oil, coal, and natural gas. The energy price series are found to have unit roots individually

We have replicated several of the univariate models for Pindyck's sample and are working on the unobserved components models. When the models are updated there appear to have been structural shifts in the DGP for the energy prices since 1996.

Next we will proceed to the forecasting exercises and forecast evaluations.

Conclusions

References

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